German Utility Model

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Light metal piston

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Light Metal Piston

The invention relates to a light metal piston for internal combustion engines in compact design, preferably with low internal height and solid block support of the pin bosses.

All forces acting on the piston are passed on to the piston pin and hence to the engine via the pin bosses. The pin bosses must therefore be designed on the one hand very strong, in order to withstand the changing stresses, and on the other hand also elastic enough to absorb the sagging and oval deformation of the piston pin without the occurrence of local and inadmissibly high stresses. For these reasons, the pin bosses have as a rule thicker walls at their upper apex than at the bottom and have a rising tapered shape in the longitudinal cross-section towards the skirt.

Supporting ribs or supporting beads towards the piston crown provided at a suitable point, and also appropriately designed for the skirt and ring belt, are particularly important for the transmission of forces.

Since the piston pin should be able to rotate inside the pin bosses, the latter must be regarded as highly stressed bearings.

The periodic deformation of the piston pin subjects the pin bosses to loading in both the horizontal and the vertical planes. The latter can in unfavourable cases cause a so-called cleavage fracture of the pin bosses. The strength-oriented dimensioning of the piston pin itself also results as a rule in a tolerable mean bearing load. In the pin bores, a mean bearing load of approx. 500 kp/cm2 should not be exceeded at the maximum ignition pressure, taking into account the usually insufficient lubrication, in the case of light metal. Regardless of this, the sagging of the piston pin generates pressures in the inner upper area of the pin bosses that can be several times the stated mean value and can then cause the feared cleavage fracture, which generally starts at the inner upper apex of the pin boss and can lead to complete fracture of the piston. To avoid these risks, it is known how to round the edge in the area of the upper inner

edge of the pin bore with 1 mm r or to design it conical with 1/100 mm or to design it to be yielding by providing undercuts (Bensinger W.-D. and A. Meier: "*Kolben, Pleuel und Kurbelwellen bei schnell laufenden Verbrennungsmotoren*", Springer-Verlag 1961, page 10).

These conventional measures are by themselves insufficient for preventing cleavage fractures in thermally and mechanically highly stressed light metal pistons as used in modern internal combustion engines with high specific output and comparatively low engine installation height, thereby also entailing a reduced piston height. Short compression heights and combustion chamber bowls in the piston crown lead to an inner height that is comparatively small, and typical for diesel engines of trucks. This distance between the piston pin and the crown, also called the expansion length, is too small to provide an elastic pin boss with undercut and ribbed support, since the radii are too small and the notch stresses are hence too high. For that reason, these pistons are usually designed with a solid block support of the pin bosses. The problem with the solid block support lies in its high stiffness, which largely prevents any adjustment to the pin deformation and hence causes high contact stresses. This results in the risk of cleavages. These start from the upper boss apex and run more or less vertically to the piston crown. Although a certain relief is possible with the aid of a larger pin clearance, a stiffer piston pin or an inclined pin boss, these measures are not sufficient to cope with the demands for further performance increases and for a more compact design.

The object underlying the invention is therefore to increase the load capacity of the pin bosses of light metal pistons for internal combustion engines in compact design of the type mentioned at the outset.

The solution of this task is that a bearing bush comprising a metallic bearing material with high strength and elongation is pressed into each bore of the pin bosses in a manner known per se, and a gap extending completely or partially around is arranged between the inner edge of the bores of the pin bosses and the outer edge of the bearing bush.

The gap can be provided either on the inner edge of the bores of the pin bosses or on the bearing bush outer edge opposite to this area or at the bore of the pin boss and on the outer edge of the bearing bush.

The gap can be limited by both straight and curved lines. It is also possible to limit the gap on

the one side by a straight line and on the other side by a curved line.

The gap has a depth of 2 to 5 % of the piston diameter and has an opening angle of greater than 0 to 6°, preferably 3°.

In most cases it is sufficient for the gap to be arranged only in the upper area of the bore of the pin boss or on the bearing bush outer circumference opposite this area and to extend up to 45° on both sides of the bore apex, with the opening angle tending towards zero.

Although it is known how to strengthen the bore of the pin boss with thickly dimensioned integrally cast or pressed-in bushes, this is only regarded as an ad-hoc solution (Becker, G.: "Vervollkommnung der Kraftfahrzeugmotoren durch Leichmetallkolben", Munich and Berlin 1922, pages 93/94).

The invention is shown in the drawings in examples that are explained in more detail in the following:

Fig. 1 shows the longitudinal section through the light metal piston 1 along the pin plane with the combustion chamber bowl 2 located in the piston head. The pin bosses 3 are designed with a solid block support. The bearing bushes 5, 6 are pressed into the bores 4 of the pin bosses. The internal height or expansion length 7 of the piston is comparatively low.

Fig. 2 is a sectional view of the longitudinal section through the pin plane of the piston 8 in the area of the one pin boss 9, into which the bearing bush 10 is pressed, with the inner edge of the pin boss being designed conical to form with the bearing bush the gap 11.

In Fig. 3, which shows the longitudinal section through the pin plane of the piston 12 in the area of the one pin boss 13, the area of the bearing bush 14 opposite the inner edge of the pin boss is designed conical, forming a gap 15 with the pin boss.

In the sectional section view of the longitudinal section in accordance with Fig. 4 through the piston 16 in the area of the one pin boss 17, the inner edge of the pin boss is rounded and the opposite area of the bearing bush 19 is designed conical, forming the gap 18.

Fig. 5 shows a section of the longitudinal section through the piston 20 by the pin plane, where the pin boss 21 is conically shaped in the area of the upper inner edge, forming the gap 22 with the pressed-in bearing bush 23. The gap 22 extends 45° from the apex of the pin boss to both sides, while the gap is narrowed towards zero.

Fig. 6 shows the end face of the inside of the pressed-in bearing bush 23 with the gap 22 arranged on the upper inner edge of the pin boss 21.

The advantage achieved with the invention is in particular that the surface tensions are reduced in the critical expansion area in that the maximum stresses are shifted from the inner edge of the pin bosses by the gap in accordance with the axial extent.

CLAIMS

1) Light metal piston for internal combustion engines in compact design, preferably with low internal height and solid block support of the pin bosses, characterized in that a bearing bush (5, 6,10, 14, 19, 23) comprising a metallic bearing material is pressed into each bore of the pin bosses (3,9, 13, 17, 21) in a manner known per se, and a gap (11, 15, 18, 22) is arranged between the inner edge of the bores of the pin bosses and the outer edge of the bearing bush opposite this area.

2) Light metal piston according to Claim 1, characterized in that the gap is arranged over the entire circumference or over a part thereof.

3) Light metal piston according to Claims 1 and 2, characterized in that the gap is arranged only at the inner edge of the bore of the pin boss and/or on the bearing bush outer edge opposite this area.

4) Light metal piston according to Claims 1 to 3, characterized in that the gap is limited by straight lines.

5) Light metal piston according to Claims 1 to 3, characterized in that the gap is limited by curved lines.

6) Light metal piston according to Claims 1 to 3, characterized in that the gap is limited on the one side by a straight line and on the other side by a curved line.

7) Light metal piston according to one or more of Claims 1 to 6, characterized in that the gap has a depth of 2 to 5 % of the piston diameter.

8) Light metal piston according to one or more of Claims 1 to 7, characterized in that the opening angle of the gap is more than 0 to 6°, preferably 3°.

9) Light metal piston according to one or more of Claims 1 to 8, characterized in that the gap is arranged only in the upper area of the bore of the pin boss and extends up to 45° on both sides of the bore apex, with the opening angle tending towards zero.